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A Method for the simultaneous estimation of the fundamental atmospheric parameters using the photometric indices

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We developed a new method to simultaneously estimate the effective temperature, surface gravity, and metallicity of cool stars using only photometric indices in the uvby color system. In a graphical method, Teff and log g were determined for all of the different values of [Fe/H] using model atmosphere grids with respect to (b−y):c1 and (b−y):m1 pair indices. Then, a 3-dim figure where X-, Y-, and Z-axes correspond to Teff, log g, and [Fe/H] was produced. By reading an intersection of two curves formed by a connection of three parameters obtained from the (b−y):c1 and (b−y):m1 pair indices on each of the three projected planes, Teff , log g, and [Fe/H] were determined simultaneously. In addition, an analytical method was devised based on the same algorithm developed for the graphical method. The new method was applied to a number of field dwarfs and giants, and the results were compared with those from a spectroscopic method and other photometric calibrations. We also estimated parameters using BVRI and JHK color system. Here, three parameter values were estimated with respect to both [(B–V):(V–R)] and [(B–V):(R–I)], [(V–K):(H–K)] and [(J–K):(H–K)] pair indices. It was confirmed that (B–V) and (V–K) indices are good temperature indicators, but all color indices for the BVRI and JHK systems are very poor indicators of metallicity and surface gravity. This new method was applied to a number of field dwarfs and giants, and the results were compared with those from the uvby color system. We found that the JHK color system can compete with the uvby system only in the estimation of temperature.